

Claims

- [c1] What is claimed is:
- 1.A power amplifier integrated circuit comprising:
a substrate,
a heat sink for dissipating heat:
a transistor disposed on the substrate, the transistor comprising a collector, a base, and at least an emitter; and
an emitter electrode directly connecting the heat sink and the emitter.
 - [c2] 2.The power amplifier integrated circuit of claim 1 wherein the transistor is a heterojunction bipolar transistor (HBT).
 - [c3] 3.The power amplifier integrated circuit of claim 1 wherein the emitter comprises a metallization layer.
 - [c4] 4.The power amplifier integrated circuit of claim 1 wherein the emitter electrode is a flip-chip bump.
 - [c5] 5.The power amplifier integrated circuit of claim 4 wherein the heat sink and substrate sandwich the transistor.
 - [c6] 6.The power amplifier integrated circuit of claim 1 wherein the emitter electrode is a backside via penetrating the substrate.
 - [c7] 7.The power amplifier integrated circuit of claim 6 wherein the heat sink and transistor sandwich the substrate.
 - [c8] 8.The power amplifier integrated circuit of claim 1 comprising more than one emitter, and emitters are mutually connected by a metallization layer.
 - [c9] 9.The power amplifier integrated circuit of claim 1 wherein the emitter electrode and the heat sink provide an electrical ground connection to the emitter.
 - [c10] 10.The power amplifier integrated circuit of claim 1 wherein the heat sink is a metal layer.
 - [c11] 11.The power amplifier integrated circuit of claim 1 wherein a plurality of

transistors and a plurality of emitter electrodes are disposed in an array, and operate as a functional device.

- [c12] 12.The power amplifier integrated circuit of claim 1 wherein the substrate is a GaAs substrate.
- [c13] 13.A method for manufacturing a heat dissipating power amplifier integrated circuit, the method comprising:
providing a substrate;
providing a heat sink for dissipating heat;
forming a transistor on the substrate, the transistor comprising a collector, a base, and at least an emitter; and
directly connecting the heat sink and the emitter using an emitter electrode.
- [c14] 14. The method of claim 13 wherein forming the transistor comprises:
disposing a metallization layer on the substrate to form the emitter; and
disposing a second metallization layer to mutually connect emitters.
- [c15] 15. The method of claim 13 further comprising:
electrically grounding the emitter through the emitter electrode and the heat sink.
- [c16] 16.The method of claim 13 further comprising:
arraying a plurality of transistors and a plurality of emitter electrodes to form a functional device.
- [c17] 17.A power amplifier integrated circuit comprising:
a substrate;
an electrically conductive layer;
a transistor formed on the substrate, the transistor comprising a collector, a base, and an emitter; and
a bump disposed on the emitter so as to connect the emitter with the electrically conductive layer for heat dissipation.
- [c18] 18.The power amplifier integrated circuit of claim 17 wherein the electrically conductive layer and the substrate sandwich the transistor.

- [c19] 19.The power amplifier integrated circuit of claim 17 wherein the electrically conductive layer provides an electrical ground connection to the emitter.
- [c20] 20.The power amplifier integrated circuit of claim 17 wherein the electrically conductive layer is a metal layer.